



FOREST PEST MANAGEMENT

Pacific Southwest Region

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AN EVALUATION OF ANNOSUS ROOT DISEASE
IN STAND 066 ON THE KNOB SALE, CANNEL MEADOW DISTRICT, SEQUOIA NATIONAL FOREST
PSW FOREST AND RANGE
EXPERIMENT STATION

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ABSTRACT

A 33-acre, mixed conifer stand was examined for the presence of root disease. Annosus root disease, caused by Fomes annosus, was found throughout the stand, principally in the fir component, although two infection centers in pine were also identified. The location and size of each root disease center is included in the report. Management alternatives are provided so that a decision as to stand treatment can be made. These include 1) no action; 2) sanitation-salvage; 3) overstory removal-precommercial thinning; 4) overstory removal-precommercial thinning-patch cut disease centers; and 5) clearcut and regenerate.

INTRODUCTION

On August 19 and 20, 1981, we met with Bill Bradley (Supervisor's Office), John Stewart, and Sue Emerson (both of Cannell Meadow District) and examined Stand 066, Powell Compartment (T.20S, R.35E, Sec. 19 & 30), of the Knob Sale. John had noted high levels of mortality and suspected the existence of root disease in the stand. Our initial observations determined that annosus root disease was infecting the white fir. We decided to survey the entire stand in order to determine the amount of root disease and the location of disease centers.

OBSERVATIONS

Stand 066, Powell Compartment, is a 33-acre, mixed conifer stand of mature to overmature timber. The principal overstory species are lodgepole pine and white fir with a smaller component of Jeffrey pine. The understory consists of dense aggregates of white fir and fewer dense patches of lodgepole pine. The first entry into the stand was about ten years ago when salvage logging was started.

We cruised the stand looking for evidence of root disease centers (windthrow, mortality, stand openings with stumps). Suspect areas were examined for signs of root disease fungi. We confirmed the presence of annosus root disease by the presence of Fomes annosus conks. We also found evidence of Armillaria root rot in some fir stumps and snags, but we considered this fungus to be of secondary importance because of the presence of F. annosus.

Altogether, 20 annosus root disease centers were identified in the stand, and their approximate locations are on the enclosed map. We marked the centers in the field with red flagging so that District personnel can accurately map them at a later date, depending on what management action is decided. In addition, we measured the approximate diameter of each center in order to determine the infested acreage in the stand (see attached Table).

Two of the centers involved pine hosts (Nos. 5 and 15); the remainder were located in fir. Two of the centers with infected fir (Nos. 6 and 8) also had windthrown pine, but conks or other evidence of F. annosus were not found in the pine.

We counted all man-made fir and pine stumps for possible later use by the District in determining the need for borax treatment (see Appendix 1). There were 112 pine stumps, one with signs of F. annosus. Of the 55 fir stumps, 18 were in annosus root disease centers. Many of these fir stumps had established butt rot indicating the probable existence of F. annosus in the tree before felling. The existence of F. annosus in the fir prior to entry is also supported by the number of infected windthrows and snags in centers without stumps.

MANAGEMENT ALTERNATIVES

A review of the biology of F. annosus is presented in Appendix 2. Against that background the following are possible actions that the District could take that would have various effects on the impact of annosus root disease in Stand 066. These alternatives are listed in the order of increasing effectiveness and cost in reducing the impact of the disease.

1. No Action. No actions would be taken in the stand. Mortality will continue in all size classes, especially in the understory fir around root disease centers. Additional windthrow will occur with the loss of timber value and possible injury of surrounding trees. Basal wounds of fir

caused by windthrows would probably become infected by decay fungi, a likely candidate being F. annosus. These infected trees could then function as foci of new disease centers. Because of the heavy recreation use, especially on the jeep trail, hazards to people and property will increase with the existence of more root-rotted trees. The high stocking levels of fir understory around dominant Jeffrey and lodgepole pines could result in increased successful bark beetle attacks to the pines, caused by their being stressed by the fir competition.

2. Sanitation-Salvage. Timber values would be salvaged, and there would be reduced risk to recreationists. However, windthrow and mortality will continue in the fir, and root disease centers will continue to expand as long as fir-to-fir root contacts exist. Because of the lack of aboveground symptoms of annosus root disease in fir, sanitation would not be effective in removing all diseased trees.

3. Overstory Removal/Precommercial Thinning. This is the prescription which was proposed for the stand. Timber values will be maximized and hazards to recreationists will be minimized. Visual quality may be impaired during and after the harvest. Mortality of the fir understory will continue around existing centers, although at lower levels; and new disease centers, in fir and pine, could be initiated. F. annosus in many of the existing centers will be expected to survive through most, if not all, of the rotation.

Leaving primarily a fir understory following an overstory removal may result in the loss of considerable volume during the rotation. With even the greatest care, the District can expect to have 10 to 15 percent of their residual stand damaged during logging. Because of the high decay susceptibility of fir and the number of years required to reach commercial size, many of the crop trees at the time of harvest will have lost at least the butt log, if not more, to decay.

4. Overstory Removal/Patch Cut/Precommercial Thinning. This is similar to the preceding alternative, but the root disease centers are more effectively handled. Root disease centers in fir would be patch cut, removing all fir, possibly with consolidation of adjacent centers when appropriate, including a buffer strip of 60 feet around each patch cut. In the cut area in and around fir infection centers pine reproduction can be retained, if desired. The patch cuts in fir may be regenerated with either Jeffrey or lodgepole pine.

Pine infection centers would also be patch cut, including a buffer strip. All tree species should be removed if it is desired to have the fungus die out before the end of the rotation. Active regeneration attempts should not be undertaken in these pine infection centers.

The residual fir understory would, again, likely suffer logging damage. However, if care is used in selecting leave trees and pine is favored, the eventual timber loss may be reduced.

5. Clearcut and Regenerate. All merchantable timber would be removed and the understory destroyed. The stand could then be planted with Jeffrey pine. If pine is planted in the pine infection centers, there is a good probability some may die. However, because of the small size of these two centers, it may be simpler to plant them and suffer some later mortality. This alternative will have the most drastic effect on visual quality, but interpretive signs may alleviate some of the public's concerns. New infection centers may be initiated by spore infection of freshly cut stumps. Infected fir stumps would have no effect on the future pine stand; however, new infections in pine stumps will result in pine mortality around them.

In addition to the above management alternatives, two other actions should be considered if any timber harvesting activities occur in the stand (Alternatives 2-5). First, treatment of freshly cut pine stumps with borax should be considered to prevent the initiation of new annosus root disease centers. Although the amount of F. annosus in pine in the stand is low, the number of spores in the air is probably high. Treating pine stumps greater than 8 inches in diameter is effective in reducing the probability of infection; smaller stumps do not need to be treated. The treatment of fir stumps is not suggested at this time because of the possibility of other avenues of infection besides stump surfaces in this species. The use of borax would require a pesticide-use proposal, economic analysis (see Appendix 1), and environmental assessment.

Second, any timber harvesting activity will create slash that can cause problems in the residual or adjacent stands. Pine slash should be promptly treated to reduce the risk of increasing the population of pine engraver beetles, Ips spp. Various methods which would reduce the probability of pine engravers building up in the slash would include logging during July and August and lopping and scattering the slash in open areas, or piling the pine slash and burning within two months of cutting, or crushing the slash with tractors. Two situations to avoid are piling the green pine slash without any further treatment, and allowing green pine slash to accumulate around the residual pine trees.

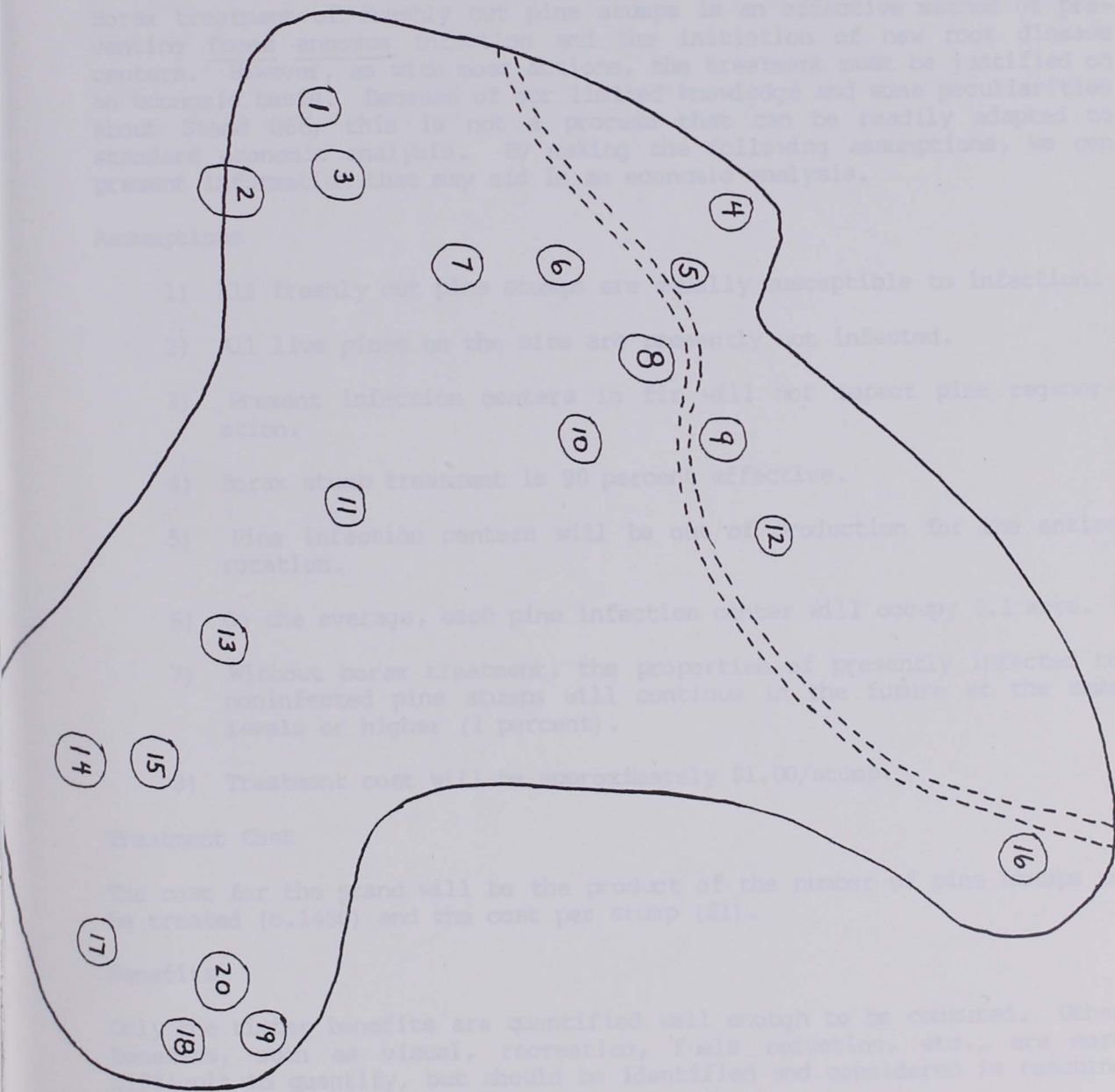
If there are any questions about this report, please contact the FPM Staff at (415) 556-6520.

SIZE OF ANNOSUS INFECTION CENTERS

PLOT NO.	APPROXIMATE DIAMETER (FEET)	APPROXIMATE ACRES INFESTED	APPROXIMATE ACRES OF PATCH CUT (INCLUDING 60 FT. BUFFER)
1	50	0.05	0.52
2	41	0.03	0.47
3	90	0.15	0.80
4	8	0.001	0.08
5 (pine)	37	0.02	0.44
6	73	0.10	0.67
7	20	0.01	0.35
8	118	0.25	1.02
9	48	0.04	0.51
10	68	0.08	0.64
11	25	0.01	0.38
12	38	0.03	0.45
13	10	0.002	0.09
14	61	0.07	0.59
15 (pine)	53	0.05	0.54
16	44	0.03	0.48
17	85	0.13	1.08
18	58	0.06	0.57
19	32	0.02	0.42
20	75	0.10	0.69
		% of Total Area	% of Total Area
TOTAL		1.23 (3.7%)	10.79 (32.7%)

Fomes annosus Centers

Stand 066, Powell Compartment



APPENDIX 1

ECONOMIC ANALYSIS FOR BORAX STUMP TREATMENT

Borax treatment of freshly cut pine stumps is an effective method of preventing Fomes annosus infection and the initiation of new root disease centers. However, as with most actions, the treatment must be justified on an economic basis. Because of our limited knowledge and some peculiarities about Stand 066, this is not a process that can be readily adapted to standard economic analysis. By making the following assumptions, we can present information that may aid in an economic analysis.

Assumptions

- 1) All freshly cut pine stumps are equally susceptible to infection.
- 2) All live pines on the site are presently not infected.
- 3) Present infection centers in fir will not impact pine regeneration.
- 4) Borax stump treatment is 90 percent effective.
- 5) Pine infection centers will be out of production for the entire rotation.
- 6) On the average, each pine infection center will occupy 0.1 acre.
- 7) Without borax treatment, the proportion of presently infected to noninfected pine stumps will continue in the future at the same levels or higher (1 percent).
- 8) Treatment cost will be approximately \$1.00/stump.

Treatment Cost

The cost for the stand will be the product of the number of pine stumps to be treated (c.1450) and the cost per stump (\$1).

Benefits

Only the timber benefits are quantified well enough to be computed. Other benefits, such as visual, recreation, fuels reduction, etc., are more difficult to quantify, but should be identified and considered in reaching a decision.

The timber benefit accrued with treatment is a function of the productivity of sites protected from infection by F. annosus. Without treatment, a minimum of 1.3 acres will be unproductive during the rotation (center size

(0.1 ac) x number of stumps (1450) x infection rate (0.01) x borax efficiency (0.9)). In addition, entries during the rotation may increase the number of infection centers if there is no treatment, but it is not possible to determine these values. The timber volume foregone on the unproductive land area during the rotation can be determined for this stand and the value computed. The timber value is the product of the estimated volume per acre for the future stand at rotation age and the present stumpage value of Jeffrey pine.

A benefit/cost analysis can be performed using the treatment cost and timber value figures discounted at the proper rate.

APPENDIX 2

BIOLOGY OF FOMES ANNOSUS

Fomes annosus is a fungus that attacks a wide range of woody plants, causing a decay of the roots and lower bole and death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed. In some instances madrone (Arbutus menziesii), and a few brush species, including manzanita (Arctostaphylos spp.) and sagebrush (Artemisia tridentata), are attacked. Infected pines are usually killed rather rapidly when the fungus girdles the root collar. Older true firs and incense-cedars usually survive infection for many years, although butt and root rot may become extensive, resulting in tree weakening and windthrow.

During favorable periods, the fungus forms fruiting bodies in decayed stumps, under the bark of dead trees, or in the duff at the root collar. The fungus becomes established in freshly cut stumps from air-borne spores produced by the conks, and then grows into the root system. True fir can also be infected by spores invading live roots and fresh basal wounds. The fungus subsequently spreads to healthy roots of surrounding susceptible tree species via root contacts. In general, infections will cross from pine to true firs; however, rarely is the fungus observed to go from true fir to pine. Local spread of the fungus outward from a stump typically results in the formation of disease centers, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach barriers such as openings or groups of nonsusceptible plants.

The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps. Young susceptible tree species often become infected and die after their roots contact old infected root systems in the soil.